**Section 6.3 Notes – Naming Compounds and Writing Formulas**

Read pages 170-175 in order to complete the reading guide and answer the questions.

Chemists use a system for naming compounds that is based on composition. In this system, the chemical name for lime is calcium oxide and its chemical formula is CaO. This formula tells you that there is a one-to-one ratio of calcium ions to oxide ions in calcium oxide. The \_\_\_\_\_\_\_\_\_\_\_\_\_ of a compound serves as a reminder of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the compound.

**Describing Ionic Compounds**

One name cannot describe all the compounds of copper and oxygen. There must be at least two names to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ red copper oxide from black copper oxide. The name of an ionic compound must distinguish the compound from other ionic compounds containing the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The formula of an ionic compound describes the \_\_\_\_\_\_\_\_\_\_\_\_ of the \_\_\_\_\_\_\_\_\_ in the compound.

***Binary Ionic Compounds***

A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ made from only \_\_\_\_\_\_\_ elements is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compound. (The Latin prefix *bi-* means “\_\_\_\_\_\_\_.” As in bicycle or bisect.) Naming binary ionic compounds, such as sodium chloride and cadmium iodide, is easy. The names have a predictable \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the \_\_\_\_\_\_\_\_\_\_\_\_\_ followed by the \_\_\_\_\_\_\_\_\_\_\_\_ of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Remember that the name for the cation is the name of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ without any change: sodium atom and sodium ion. The name for the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ uses part of the name of the nonmetal with the suffix *–\_\_\_\_\_\_\_\_\_\_\_\_\_:* iodine atom and iodide ion. The figure below shows the names and charges for eight common anions.

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| ***Common Anions*** |
| **Element Name** | **Ion Name** | **Ion Symbol** | **Ion Charge** |
| Fluorine | Fluoride | F- | 1- |
| Chlorine | Chloride | Cl- | 1- |
| Bromine | Bromide | Br- | 1- |
| Iodine | Iodide | I- | 1- |
| Oxygen | Oxide | O2- | 2- |
| Sulfur | Sulfide | S2- | 2- |
| Nitrogen | Nitride | N3- | 3- |
| Phosphorus | Phosphide | P3- | 3- |

***Metals With Multiple Ions***

The alkali metals, alkaline earth metals, and aluminum form ions with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charges equal to the\_\_\_\_\_\_\_\_\_\_\_ number. For example, the symbol for a potassium ion is K+, the symbol for a calcium ion is Ca2+, and the symbol for an aluminum ion is Al3+.

Many \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ metals form more than one \_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_. Notice the two copper ions listed in the figure below, a copper (I) ion with a 1+ charge and a copper (II) ion with a 2+ charge. When a metal forms more than one ion, the name of the ion contains a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to indicate the \_\_\_\_\_\_\_\_\_\_\_\_\_ on the ion. These ion names can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ red copper (I) oxide from black copper (II) oxide. The formula for “copper one oxide” is Cu2O because it takes two Cu1+ ions to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ out the charge on an O2- ion. The formula for “copper two oxide” is CuO because it takes only one Cu2+ ion to balance the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on an O2- ion.

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| ***Some Metal Cations*** |
| **Ion Name** | **Ion Symbol** | **Ion Name** | **Ion Symbol** |
| Copper(I) | Cu+ | Chromium(II) | Cr2+ |
| Copper(II) | Cu2+ | Chromium(III) | Cr3+ |
| Iron(II) | Fe2+ | Titanium(II) | Ti2+ |
| Iron(III) | Fe3+ | Titanium(III) | Ti3+ |
| Lead(II) | Pb2+ | Titanium(IV) | Ti4+ |
| Lead(IV) | Pb4+ | Mercury(II) | Hg2+ |

***Polyatomic Ions***

A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonded group of atoms that has a positive or negative charge and acts as a \_\_\_\_\_\_\_\_\_\_\_\_is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion. The prefix *poly-* means “\_\_\_\_\_\_\_\_\_\_.” Most simple polyatomic ions are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The figure below lists the names and formulas for some polyatomic ions. Sometimes there are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a formula that includes polyatomic ions. For example the formula for iron (III) hydroxide is Fe(OH)3. The subscript 3 indicates that there are \_\_\_\_\_\_\_\_\_\_\_ hydroxide ions for each iron (III) ion.

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| ***Some Polyatomic Ions*** |
| **Name** | **Formula** | **Name** | **Formula** |
| Ammonium | NH4+ | Acetate | C2H3O2- |
| Hydroxide | OH- | Peroxide | O22- |
| Nitrate | NO3- | Permanganate | MnO4- |
| Sulfate | SO42- | Hydrogen sulfate | HSO4- |
| Carbonate | CO32- | Hydrogen carbonate | HCO3- |
| Phosphate | PO43- | Hydrogen phosphate | HPO42- |
| Chromate | CrO42- | Dichromate | Cr2O72- |
| Silicate | SiO32- | Hypochlorite | OCl- |

***Writing Formulas for Ionic Compounds***

If you know the \_\_\_\_\_\_\_\_\_\_ of an ionic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, you can write its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Place the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cation first, followed by the symbol of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_. Use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to show the \_\_\_\_\_\_\_\_\_\_\_\_ of the ions in the compound. Because all compounds are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the total charges on the cations and anions must add up to \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Suppose an atom that gains two electrons, such as sulfur, reacts with an atom that loses one electron, such as sodium. There must be two sodium ions (Na+) for each sulfide ion (S2-). The formula for sodium sulfide is Na2S. The 2- charge on one sulfide ion is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by the 1+ charges on two sodium ions.

**Describing Molecular Compounds**

Like ionic compounds, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compounds have names that identify \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compounds, and formulas that \_\_\_\_\_\_\_\_\_\_\_\_\_ those names. With molecular compounds, the focus is on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The name and formula of a molecular compound describe the \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_\_ in a molecule of the compound.

***Naming Molecular Compounds***

The general rule is that the most \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ element appears \_\_\_\_\_\_\_\_\_\_ in the name. These elements are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the \_\_\_\_\_\_\_\_\_ in the periodic table. If both elements are in the same group, the more metallic element is closer to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the group. The name of the second element is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to end in the suffix *–ide*, as in carbon dioxide.

Two compounds that contain nitrogen and oxygen have the formulas N2O4 and NO2. The names of these two compounds \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the actual number of \_\_\_\_\_\_\_\_\_\_ of nitrogen and oxygen in a molecule of each compound. You can use the Greek \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the figure below to describe the number of nitrogen and oxygen atoms in each molecule.

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| ***Prefixes for Naming Compounds*** |
| **Number of Atoms** | **Prefix** |
| 1 | Mono- |
| 2 | di- |
| 3 | Tri- |
| 4 | Tetra- |
| 5 | Penta- |
| 6 | Hexa- |
| 7 | Hepta- |
| 8 | Octa- |
| 9 | Nona- |
| 10 | Deca- |

In an N2O4 molecule, there are two nitrogen atoms and four oxygen atoms. The Greek prefixes for two and four are *di-* and *tetra-*. The name for the compound with the formula N2O4 is dinitrogen tetraoxide. In an NO2 molecule, there are one nitrogen atom and two oxygen atoms. The Greek prefixes for one and two are *mono-* and *di-*. So a name for the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with the formula NO2 is mononitrogen dioxide. However, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ *mono-* often is \_\_\_\_\_\_\_\_\_\_\_ used for the \_\_\_\_\_\_\_\_\_\_\_\_\_ element in the name. A more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ name for the compound with the formula NO2 is nitrogen dioxide.

***Writing Molecular Formulas***

Writing the formula for a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compound is easy. Write the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for the elements in the \_\_\_\_\_\_\_\_\_ the elements \_\_\_\_\_\_\_\_\_\_\_\_\_ in the name. The prefixes indicate the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_ of each element in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The prefixes appear as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the formulas. If there is \_\_\_\_\_\_\_ prefix for an element in the name, there is only \_\_\_\_\_\_\_\_\_ atom for that element in the molecule.

What is the formula for diphosphorus tetrafluoride? Because the compound is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, look for elements on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ side of the periodic table. Phosphorus has the symbol P. Fluorine has the symbol F. *Di-* indicates two phosphorus atoms and *tetra-* indicates four fluorine atoms. The formula for the compound is P2F4.

***Comprehension Questions***

1. What does the formula of an ionic compound describe?
2. What do the name and formula of a molecular compound describe?
3. What suffix is used to indicate an anion?
4. Why are Roman numerals used in the names of compounds that contain transition metals?
5. What is a polyatomic ion?